NON-PUBLIC?: N
ACCESSION #: 9108130346
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Catawba Nuclear Station, Unit 1 PAGE: 1 OF 07

DOCKET NUMBER: 05000413

TITLE: Reactor Trip on Turbine Trip Due to Loss of Both Main Feedwater Pumps on Low Suction Pressure
EVENT DATE: 07/10/91 LER #: 91-015-00 REPORT DATE: 08/08/91

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 92

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SN COMPONENT: XCV MANUFACTURER: M430
X SD XCV F130
F BA XCV M430
REPORTABLE NPRDS: N
Y
Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On July 10, 1991, at approximately 0901 hours, with Unit 1 in Mode 1, Power Operation, and operating at 92% Reactor power level, a Reactor (Rx) trip occurred as a result of a Turbine trip above P-9 (69% Reactor power). The Turbine tripped because of loss of both Main Feedwater (CF) pumps on low suction pressure. The low suction pressure condition occurred during a secondary side transient which began when the heater drain (HW) tank pump 1C1 outlet control valve (1HW59) failed closed as the control air signal line from the level controller to the valve positioner broke. This prevented 1C1 heater drain tank pump flow from entering the Condensate (CM) system, reducing CF pump suction pressure. The standby CM Booster Pump and Hotwell pump had been tagged out for

preventive maintenance prior to the transient and were unavailable. While the operators were reducing load to recover CF pump suction pressure, the pumps tripped on low suction pressure. The Turbine and Reactor trips followed. This incident is attributed to a possible Design/Construction/Installation Deficiency. Metallurgical analysis showed that the failure was caused by vibration coupled with excessive stress loading at the positioner fitting. The failed tubing was replaced, and expansion coils were added.

END OF ABSTRACT

BACKGROUND

The Condensate EIIS:SD! (CM) system begins with the hotwell pumps EIIS:P! taking suction from the condenser hotwell. During normal operation, two hotwell pumps will be operating with the third in standby. After the hotwell pumps, the condensate flows to the condensate polishing demineralizers. Downstream of the Condensate polishing demineralizers, the condensate is divided equally between the three condenser steam air ejectors (CSAEs). After the CSAEs, the condensate flows in parallel through the gland steam condenser and the blowdown recovery heat exchangers EIIS:HX!. The condensate then passes through two stages of low pressure feedwater heaters to the suction of the condensate booster pumps.

A bypass is provided from the hotwell pump discharge, around the other equipment discussed above, to the condensate booster pump suction manifold. The generator EIIS:GEN! load rejection bypass control valve EIIS:V! (1CM83) has two positions on its control switch EIIS:XIS!, auto and closed. In the auto position, valve 1CM83 will open and throttle to maintain adequate condensate booster pump suction pressure during all operating modes. In the closed position, valve 1CM83 will be closed except during a generator load rejection or loss of one main feedwater pump above 56% load. In either of these two cases, the valve will open automatically and throttle to maintain adequate condensate booster pump suction pressure.

During normal operation, two condensate booster pumps will be in operation with the third in standby. Downstream of the condensate booster pumps, the condensate passes through three stages of intermediate pressure feedwater heater,s before combining with the "C" heater drain pump flow and discharging to the suction of the feedwater pumps.

The Feedwater EIIS:SJ! (CF) system contains two feedwater pumps.

Normally, both pumps will be operating with each pump handling half of the feedwater flow. Feedwater-pump low suction pressure alar ms in the control room, and low-low suction pressure trips the associated pump with a twenty second time delay and a two out of three trip logic. Downstream of the feedwater pumps, the feedwater passes through two stages of high pressure feedwater heaters to a final feedwater header where the feedwater temperature is equalized. The feedwater is then admitted to the steam generators through the four steam generator feedwater lines EIIS:PSP!, each of which contains a feedwater control valve and a feedwater flow nozzle.

Feedwater flow to the individual steam generators is controlled by a three element feedwater control system EIIS:JB! using feedwater flow, steam generator water level, and main steam flow as control parameters for the steam generator feedwater control valves (1CF 28, 37, 46, and 55) and feedwater control bypass valves (1CF30, 39, 48, and 57). Main feedwater pump speed is

varied to maintain a programmed differential pressure (D/P) between the main steam header and the feedwater discharge header. The speed controller EIIS:XC! continuously compares the actual D/P with a programmed reference pressure (Pref) which is a linear function of steam flow.

The Auxiliary Feedwater EIIS-BA!(CA) System assures sufficient feedwater supply to the steam generators (S/Gs) in the event of loss of the CM/CF systems. The system is designed to start automatically in the event of loss of offsite electrical power, trip of both CF pumps, safety injection signal (SS), or low-low steam generator water level, any of which may result in, coincide with, or be caused by a Reactor trip.

The CA System consists of three auxiliary feedwater pumps, each powered from separate and diverse power sources. Two full capacity motor EIIS:MO! driven pumps are capable of supplying feedwater to two steam generators. These pumps will start automatically and provide flow within one minute following initiation of the system. Initiation conditions are any one or combination of the following: 2 of 4 low-low level alarms in any 1 of 4 S/Gs, loss of all CF pumps, initiation of a SS, or loss o

offsite power. Valve 1CA40B is the CA pump 1B discharge to S/G D control valve. Valve 1CA42B is the CA pump 1B discharge to S/G D isolation valve, downstream of 1CA40B.

In addition, a turbine EIIS:TRB! driven CA pump is capable of supplying feedwater to two S/Gs. The turbine driven pump will start automatically and provide flow. The pump will start automatically on one or both of the following conditions: 2 of 4 low-low level alarms in any 2 of 4 S/Gs; loss of offsite power.

The Moisture Separator/Reheater EIIS:SM! and Feedwater Heater Drains System EIIS:SN! is designed to return to the Condensate Feedwater System all condensate drains from the following equipment: high and low pressure feedwater heaters, moisture separator drains, first and second stage reheater drains, and feedwater purge seal bleedoff flow.

The combined drains from the A and B feedwater heaters and the drains from the C feedwater heaters, as well as moisture separator drain tanks and a small amount of feedwater p ump seal bleedoff, drain to the C feedwater heater drain tanks. All of the drains collected in the two C feedwater heater drain tanks are pumped forward to a point immediately upstream of the main feedwater pump suction in the CM/CF system by two C feedwater heater drain tank pumps. Level control is maintained in the drain tanks by valves which regulate the discharge flow from these pumps (valves 1HW59 and 1HW60 for the 1C1 and 1C2 heater drain tanks, respectively). Emergency drains to the condenser are provided for the C feedwater heater drain tanks (valves 1HW41 and 1HW42 for the 1C1 and 1C2 heater drain tanks, respectively).

EVENT DESCRIPTION

On July 10, 1991, Unit 1 was operating in Mode 1, Power Operation, at 100% Reactor Power level. Condensate (CM) Booster Pump C and Hotwell Pump C were tagged out for preventive maintenance, and were unavailable.

At 08:38:50 hours, the operator received a main feedwater pump turbine (CFPT) speed alarm on CFPT 1B. The operators investigated and determined that both Main Feedwater (CF) pumps had increased in speed. This indicated that the problem was condensate flow, not CF pump, related. Upon further investigation, the operators determined that the 1C1 heater drain (HW) tank to condenser control valve (1HW41) was open. An operator was dispatched to the 1C1 heater drain tank flow control valve (1HW59) in an attempt to take manual control. He found that the valve was closed and not responding.

The Shift Supervisor observed the low suction pressure, and at 09:00:45 hours ordered a slow load reduction (approximately 2 MWe per minute) in an effort to increase CF pump suction pressure. Fifteen seconds later, the CF pump suction header pressure low alarm was received. At this time the Shift Supervisor directed that the turbine controls be taken to manual and load reduction rate increased. As the heater drain pump input to the condensate flow decreased, the hotwell and booster pump flow rate increased with a corresponding drop in developed head. CF pump suction pressure continued to decrease. At 09:01:10 hours, the main steam bypass to condenser valves began to open as a result of the load reduction reducing steam (and thus feedwater) pressure. CF pump suction pressure then dropped rapidly below the low suction pressure trip setpoint. The CF pumps tripped on low suction pressure at 09:01:36 hours. The Turbine subsequently tripped on loss of both main feedwater pumps, and the Reactor tripped at 09:01:37 hours on Turbine trip because power was above P-9 (69% Reactor power). Auxiliary feedwater pumps A and B automatically started on loss of both CF pumps.

Following the Reactor trip, the unit was stabilized in Mode 3, Hot Standby. The closing of valve 1HW59 was determined to be caused by failure of the control air signal line from the level controller to the valve positioner EIIS:XCV!. The valve failed closed on loss of air, as designed. Post-trip investigation determined that the load rejection bypass valve (1CM83) failed to open to maintain CM Booster Pump suction pressure. A work request was written to investigate the failure of 1CM83 to open. Plant response to the trip was essentially normal, with the following exceptions. Valve 1CA40B (Auxiliary Feedwater Pump B Discharge to Steam Generator D Control) could not be throttled when placed in manual control. The operators used 1CA42B (Auxiliary Feedwater Pump B discharge to Steam Generator D isolation -- the downstream motor operated isolation valve) to control auxiliary feedwater flow. Investigation determined that the valve failed to respond due to dirt internal to the valve positioner. During the post-trip review, Performance

determined that flow from Auxiliary Feedwater (CA) Pump 1A to Steam Generator A was slightly below the acceptable band. An A train CA flow balance was performed to correct the problem.

CONCLUSIONS

The closing of valve 1HW59 was determined to be caused by a possible Design/Construction/Installation Deficiency. Metallurgical analysis showed that the failure was caused by vibration coupled with excessive stress loading at the point of the tubing fitting. This resulted in failure of the control air signal line from the level controller to the valve positioner. The valve failed closed on loss of air, as designed. The copper tubing on the 1C1 and 1C2 heater drain tank pump outlet control valves (1HW59 and 1HW60) was replaced with new copper tubing, and expansion coils were added. This failure is not reportable to NPRDS as this valve is outside the NPRDS scope. The use of flexible tubing for the air lines to the 1C1 and 1C2 heater drain tank outlet flow control valves (1HW59 and 1HW60) will be investigated. Other critical secondary side air operated valves, which could initiate a transient if tubing were to fail, will be identified and the desirability of changing to flex tubing will be evaluated.

The failure of 1CM83 to open is attributed to a Possible Equipment Failure/Malfunction, and will be investigated under Work Request (W/R) 7974 PRF. This failure is reportable to NPRDS. The standby (C train) Hotwell Pump and Condensate (CM) Booster Pumps were out of service for preventive maintenance. The frequency of preventive maintenance on the Hotwell and Condensate Booster Pumps was reviewed and determined to be appropriate. The feasibility of maintaining either One Hotwell Pump or Condensate Booster Pump as an available standby at all times will be evaluated. In addition, the need for providing mini-flow protection for the C Heater Drain Tank Pumps will be considered.

The flow to Steam Generator 1A was slightly below that of the original flow balance established in the recent Unit 1 refueling outage. The A train flow was increased slightly, and the flow balanced. As a result of this, procedure PT/1(2)/A/4250/03E, "CA System Discharge Control Valve Throttling Procedure," will be changed to require running an additional flow balance after the valve throttle position and handwheel are left in their final position.

1CA40 failed to control when manual control was assumed due to dirt internal to the valve positioner. The valve positioner was cleaned, recalibrated, and retested satisfactorily. This failure is reportable to NPRDS.

A search of the Operator Experience Program (OEP) data base for the past 24 months revealed one Reactor and main Turbine trip as a result of a main feedwater pump trip. LER 414/90-13 describes an event where the 2A main feedwater pump tripped due to an erroneous high discharge pressure signal, caused by failed diaphragms in 2 out of 3 pump discharge pressure switches.

This event was attributed to equipment failure. Because of the difference in equipment and root cause, this event is not considered to be recurring under Nuclear Safety Assurance guidelines.

CORRECTIVE ACTIONS

IMMEDIATE

1. Operators reduced turbine load before the trip to recover suction pressure on the CF pumps.

2. Operations personnel responded to the trip and recovered Unit 1 to normal Mode 3, Hot Standby, condition.

3. Operators controlled auxiliary feedwater (CA) to Steam Generator D using the motor operated isolation valve (1CA42B) since the control valve (1CA40B) failed to respond in manual.

SUBSEQUENT

1. The tubing which supplies the 1C1 and 1C2 heater drain tank flow control valve (1HW59 and 1HW60) positioners was replaced with new copper tubing, and expansion coils were added.

2. The positioner for valve 1CA40B was cleaned and recalibrated.

3. The flows from CA pump 1A to Steam Generators A and B were balanced.

4. Performance reviewed the operation of the Hotwell and Condensate Booster Pumps to ensure that there was no degradation and to determine the cause of the Main Feedwater (CF) pump trip.

5. The frequency of preventive maintenance on the hotwell and condensate booster pumps was reviewed and determined to be appropriate.

6. The instrument tubing which failed was sent out for metallurgical analysis to determine the cause of the failure.

PLANNED

1. The use of flexible tubing in the air lines to the 1,2C1 and 1,2C2 heater drain tank outlet flow control valves (1,2HW59 and 1,2HW60) will be investigated.

2. Procedure PT/1(2)/A/4250/03E, "CA System Discharge Control Valve Throttling Procedure," will be changed to require running an additional flow balance after the valve throttle position and handwheel are left in their final position.

3. Other critical secondary side air operated valves, which could initiate a transient if tubing were to fail, will be identified, and the desirability of changing to flex tubing will be evaluated.

4. The feasibility of maintaining either the Hotwell Pump or Condensate Booster Pump as an available standby pump at all times will be evaluated. In addition, the need for providing mini-flow protection for the C Heater Drain Tank Pumps will be considered.

5. The failure of 1CM83 to open will be investigated under Work Request 7974 PRF.

SAFETY ANALYSIS

Reactivity was controlled by the Reactor trip. All
ods EIIS:ROD!
inserted, as expected. Residual heat was removed from the Reactor to the ultimate heat sink via Auxiliary Feedwater (CA). CA flow control valve 1CA40B failed to control properly in manual. However, the valve went open, its safe position, upon CA demand. The operators controlled CA flow to Steam Generator D using 1CA42B, the motor operated isolation valve downstream of 1CA40B. The Auxiliary Feedwater flow from motor driven CA pump A to steam generator A was below the acceptance criteria. However, narrow range level remained on-scale at all times. The turbine driven CA pump was available, if required, to provide additional CA flow. No unusual release of radioactivity occurred. With the exceptions noted above, all safety systems functioned as designed.

A Reactor trip on loss of both main feedwater pumps is bounded by the "Loss of Normal Feedwater" transient described in section 15.2.7 of the Catawba FSAR. This transient assumes only one motor driven Auxiliary Feedwater pump delivers flow to the steam generators.

The health and safety of the public were not affected by this event.

ATTACHMENT 1 TO 9108130346 PAGE 1 OF 1

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DUKE POWER

August 8, 1991

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Catawba Nuclear Station
Docket No. 50-413
LER 413/91-15

Gentlemen:

Attached is Licensee Event Report 413/91-15, concerning REACTOR TRIP ON TURBINE TRIP DUE TO LOSS OF BOTH MAIN FEEDWATER PUMPS ON LOW SUCTION
PRESSURE.

This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

J. W. Hampton
Station Manager

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